

Mechanisms for the export of archaeal lipids down the water column in the upwelling area off Cape Blanc, North-West Africa

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Transport mechanisms of microbial membrane lipids from surface waters to the seafloor are poorly understood. In particular, pelagic archaeal glycerol dibiphytanyl glycerol tetraethers (GDGTs) from planktonic archaea are frequently used for reconstruction of ancient sea surface temperatures (Schouten et al. 2013). Because planktonic archaea are too small and neutrally buoyant to sink independently, transport vehicles for efficient export of fossil archaeal biomarkers to the sediment are required.

The surface ocean is coupled with the deep ocean through biogenic sinking particles, a process known as the biological pump (Volk and Hoffert 1985). Two different pathways for particle formation, mainly taking place in the mesopelagic zone, are distinguished: Direct aggregation of phytoplankton blooms or grazing, resulting in phyto-detrital aggregates or reprocessed faecal material, respectively. Grazing and packaging into sinking particles is a possible export mechanism for GDGTs (Huguet et al. 2006). Moreover, it is assumed that phyto-detrital aggregates also play an important role in transporting GDGTs to the deep (Mollenhauer et al. 2015), but processes behind this pathway remain unclear. However, there are only few studies that link GDGT signals in sinking particles to the composition of the exported particulate matter (e.g. Yamamoto et al., 2012; Mollenhauer et al. 2015).

Here we investigate sinking particles and suspended particulate matter (SPM) from spring blooms in 2012 and 2013 in the upwelling region in the Atlantic Ocean off Cape Blanc, Mauritania. We compare for the first time material from free-floating sediment traps (100, 200 and 400 m; purely sinking particles) with sinking particles and SPM from size fractionated in-situ pump (ISP) filters (several depths between 40 and 2350 m). This setup allows to relate the signal from archaeal lipids to (i) the flux of particulate organic carbon and the particle assemblages as revealed by the characterisation of thousands of individual particles collected in gels in addition to (ii) the sinking particles and SPM present in different particle size fractions on the filters. First results show that the large size fraction carries relatively more intact lipids indicating fresh material being attached to sinking particles rather than suspended in the water column. Furthermore, the distribution of 1G-GDGTs over depths differs from that of 2G- and HPH-GDGTs which might relate to different archaeal communities at different depths. Our findings contribute to the mechanistic understanding of the export of organic molecules through the water column and support the validation of lipid-based paleoceanographic proxies.

References

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